Forecasting Productivity of Scraper

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Abstract: ***Productivity estimating of earthwork equipment is an essential tool for the successful completion of the earthwork process. Productivity operation is characterized as yield of the hardware per unit of time. Estimating equipment operation efficiency is experience-based because of the many-sided quality included. As per experience, a contractual worker can naturally alter the standard rates in profitability handbooks to appraise for an operation in given task conditions. Notwithstanding, such exact practices don't promise a reliable evaluation because of the absence of a equipment that relates the present case to past examples. The research aims to find factors affecting of scraper productivity and then derivation of an equation to predict the rates of scraper productivity by using a regression program. A formal methodology is recording the genuine operation efficiency saw in different employment conditions, then the gathered specimens are handled by a regression program to build up the connections can be used for productivity estimation. The primary explanation behind utilizing a regression program for profitability estimation is the necessity of performing complex mapping of environment and management elements to profitability. The more effective factor on the scraper productivity by using a regression program are the slope of 24 % importance least effective factor is the rolling resistance of 4% importance.***

Keywords: Earth Work Forecasting Productivity of Scraper

1. Introduction

Profitability is normally characterized as a proportion between the yield volume and the volume of inputs. As it were, it gauges how effectively generation inputs, for example, work and capital, are being utilized as a part of an economy to create a given level of yield[8].[5]. Productivity (p) is nothing other than the relationship between the generation (P) of a good or service and the variables of creation utilized, yet it is an idea that is clearly simple to characterize yet hard to quantify [4].

To determine productivity rates, it is necessary to obtain the hours and costs expended as well as the amounts of work put into place[12][7] ,so it means that the productivity amount straightforwardly impacts gainfulness, for instance utilizing a machine that does not have enough limit will back off efficiency[2] .

2. Scraper Productivity

Scrapers are designed to load, haul, and dump loose material. The greatest advantage is their versatility. They can be used for a wide variety of material types and are economical for a range of haul distances and conditions.

Scrapers are articulated; tractor powered, and pull a bowl that holds the soil. A blade is mounted on the bottom of the bowl that cuts into the travel surface and the disturbed soil flows into the bowl as the scraper moves forward [6]. Scrapers can self-load or be assisted by another.

To load the scraper, the front end of the bowl (nearest the cab) is lowered until the attached cutting edge penetrates the travel surface. As the scraper moves forward, the front apron of the bowl is raised so that a strip of excavated earth can flow into the bowl. The amount of excavated soil depends on the depth of penetration of the cutting edge. The scraper moves forward until the bowl is full. The blade is lifted and the apron closes. Ripping (bulldozer with ripper shanks) or tilling (tractor pulling a plow) the soil lift to be excavated prior to the scraper making a pass can increase scraper production. Sometimes applying water will loosen soil also [11].

To dump the scraper load, the cutting edge is set above the discharged material, raising the apron. The material is forced out by means of a movable ejector mounted at the rear of the Shuttle loading, Chain loading, Back-track loading, Pusher tractor.

The capacity of the scraper bowl can be measured by volume or weight. When the capacity or the weight is exceeded, operating efficiency decreases. Scraper volume is measured in two ways in loose cubic yards. Struck volume is the loose cubic yards that a scraper would hold if the top of the material were struck off even at the top of the bowl. Heaped volume is the loose cubic yards that a scraper would hold with the material heaped and sloping above the sides of the bowl. The heaped volume takes into account the fill factor.[10]

The cycle time for a scraper is estimated by adding the fixed times to load, dump, turn around, and spot for the next cut, and the variable or travel times to haul full and return empty. Scraper rimpull, speed, and gradability performance can be verified by referring to the rimpull, speed, and gradability curves for the model. The expected performance of the scraper can be compared to these operating requirements of the work. Dozer-assisted means that the dozer makes contact with the back bale of the scraper as itstarts into the hole. The dozer is actually providing most of the pushing power to not only make the cut, but also to transport the full bowl through and out (boost) of the cut. This greatly optimizes what a bulldozer is designed to do and greatly reduces the power needed by the scraper to excavate and start hauling when fully loaded. It is an ideal pairing of equipment to optimize the capabilities of both [8]. The production rate of a scraper is a function of (slope, distance, loading, choice of equipment, maintenance, experience, weather, soil type, labour bonus, and rolling resistance).[13][3][1][9].

1. Slope: is a measure of the power because of gravity, which must be overcome as the machine climbs a slope, yet is perceived as evaluation help while moving downhill. Evaluations are for the most part measured in percent incline.

2. Distance: increasing the distance of movement would decrease the cycle time of scraper. Investigations of burden volume versus stacking time show that for a typical operation, around 85 percent of scrubber burden limit is accomplished in the initial 0.5 moment of stacking. An additional 0.5 moment will just deliver about another 12 percent expansion in burden volume. Along these lines, additional stacking time (past around one moment) is not worth the impact on the grounds that expanded aggregate process duration will diminish creation.
3. Loading (movement system): Crawler can operate on steeper side slopes, climb greater grades than can wheel mounted, and can operate in rough terrain. Apply low ground pressure, 6-9 lb/in² so good in low trafficable areas. On the other hand, wheel dozers can move faster than crawler and move on paved roads without damaging its surface.
4. Choice of equipment: there must be a technique used to determine the best decision in light of the amount of work and particular site contemplation. Abstaining from repositioning and keeping the scrubber going ahead will streamline generation time.
5. Maintenance: a program of normal turn of operational vehicle for on location preventive support decreases the measure of hardware time lost to unscheduled breakdowns and this will be helpful in maximizing the scraper productivity.
6. Experience: This includes operator's involvement with comparative model hardware and past mischance history
7. Weather: a scraper may achieve high week after week generation rates if there is no unfavorable climate amid the whole employment. Then again, a venture that was tormented with terrible climate and sloppy working conditions would encounter underneath typical generation rates.
8. Soil type: The physical properties of mud, rock, natural matter, shake, sand, or residue to be moved impacts the sort of scraper and this is important in order to increase the productivity of scraper.
9. Labour bonus: increasing the salaries or providing bonus may accordingly increase the productivity of the scraper.
10. Rolling resistance (RR): is the power that must be applied to roll or draw a wheel over the ground. It is an element of the inward contact of orientation, tire flexing, tire infiltration into the surface, and the weight on the wheels [1].

Regression

1) Identifying the weights for all the factors related to scraper productivity depending on the condition of the site and equipment from references in the table (1).
2) Enter the work study results and analyzing them using (linear regression analysis) table (3) in order to find the importance of every factor and compare the actual productivity with the expected table (2).

Table 1: The weights for all the factors related to scraper productivity

Factor	Type	Weight
Soil type	Clay	0.85
	Sand	0.95
	Gravel	0.9
RR	Earthy Clay	0.85
	Earthy Sand	0.88
	Earth	0.8
Weather	Bad	0.8
	Normal	0.88
	Good	0.95
Loading Technique	Wheel	0.8
	Crawler	0.95
Choice of equipment	Less Appropriate	0.75
	Appropriate	0.85
	Very Appropriate	0.95
Bonus	Monthly	0.82
	Weekly	0.85
	Daily	0.88
Experience	1-5	0.75
	5-10	0.85
	10-15	0.88
	20>	0.9
Maintenance	None	0.75
	Sudden	0.8
	Period Ic	0.85
	Programing	0.9
Distance	500>	0.8
	500<	0.9
Slop	Ascending	0.7
	Level	0.9

Table 2: The differences between actual andexpected productivity

Actual A	Expected E	A-E
95.6	95.26	0.34
93.2	93.19	0.01
94.5	95.4	0.1
91.9	92.01	-0.11
92.7	92.21	0.49
96.8	96.8	0
92.7	93	-0.3
94.5	94.51	-0.01
95.8	95.71	0.09
94	93.44	0.56
97.7	97.37	0.33
94.8	94.85	-0.05
96.2	95.66	0.54
90.6	91.08	-0.48
94.7	95.09	-0.39
92.6	92.33	0.27
95	95.54	-0.54
92.1	92.4	-0.3
92.2	91.81	0.39
92.9	92.34	0.56
95.9	96.32	-0.42
97.6	97.35	0.25
94.1	93.73	0.37
93	93.36	-0.36
92.3	92.09	0.21
94.7	95.35	-0.65
92.1	92.29	-0.19
96.1	95.72	0.38
90.4	90.77	-0.37
94.6	94.3	0.3

Table 3: The Work Study Values

Soil type	RR	Weather	Loading	Choose of equipment	Bonus	Experience	Maintenance	Distance	Slop	Actual
0.9	0.8	0.95	0.8	0.75	0.85	0.9	0.8	0.95	0.9	95.6
0.85	0.85	0.95	0.8	0.85	0.88	0.85	0.75	0.95	0.7	93.2
0.95	0.88	0.95	0.8	0.95	0.85	0.75	0.9	0.95	0.7	94.5
0.85	0.85	0.8	0.95	0.75	0.82	0.8	0.8	0.8	0.7	91.9
0.9	0.8	0.95	0.8	0.75	0.85	0.9	0.8	0.95	0.7	92.7
0.85	0.85	0.95	0.8	0.85	0.88	0.85	0.75	0.95	0.7	96.8
0.95	0.88	0.95	0.8	0.95	0.85	0.75	0.9	0.95	1	92.7
0.85	0.8	0.95	0.95	0.75	0.82	0.85	0.8	0.8	1	94.5
0.95	0.85	0.88	0.8	0.95	0.75	0.88	0.73	0.8	1	95.8
0.95	0.88	0.88	0.95	0.85	0.88	0.9	0.85	0.9	0.9	94
0.85	0.8	0.88	0.8	0.75	0.78	0.85	0.9	0.8	0.9	97.7
0.95	0.85	0.88	0.8	0.85	0.85	0.75	0.85	0.8	0.9	94.8
0.9	0.88	0.88	0.8	0.95	0.78	0.85	0.9	0.8	0.9	96.2
0.85	0.8	0.88	0.8	0.85	0.88	0.75	0.8	0.95	0.9	90.6
0.95	0.85	0.88	0.95	0.95	0.78	0.88	0.75	0.95	0.9	94.7
0.95	0.88	0.8	0.8	0.75	0.82	0.9	0.85	0.95	0.7	92.6
0.85	0.85	0.88	0.95	0.85	0.88	0.85	0.9	0.8	0.7	95
0.95	0.8	0.8	0.8	0.75	0.85	0.75	0.8	0.8	0.7	92.1
0.85	0.85	0.88	0.95	0.85	0.75	0.85	0.75	0.95	0.7	92.2
0.95	0.88	0.88	0.8	0.75	0.82	0.75	0.83	0.95	0.7	92.9
0.85	0.85	0.88	0.95	0.95	0.95	0.88	0.88	0.8	0.95	95.9
0.9	0.8	0.95	0.8	0.8	0.75	0.85	0.85	0.75	0.95	97.6
0.9	0.88	0.88	0.85	0.8	0.95	0.75	0.75	0.9	0.8	94.1
0.85	0.85	0.95	0.9	0.95	0.75	0.82	0.85	0.8	0.8	93
0.95	0.8	0.8	0.9	0.95	0.95	0.85	0.9	0.75	0.8	92.3
0.95	0.8	0.8	0.95	0.95	0.85	0.9	0.75	0.8	1	94.7
0.95	0.85	0.95	0.8	0.85	0.88	0.85	0.85	0.8	1	92.1
0.85	0.8	0.8	0.8	0.85	0.85	0.9	0.9	0.8	1	95.6
0.9	0.8	0.88	0.8	0.95	0.75	0.85	0.8	0.8	0.9	93.2
0.9	0.85	0.88	0.8	0.85	0.85	0.75	0.75	0.8	0.9	94.5
0.85	0.88	0.88	0.95	0.95	0.75	0.85	0.85	0.8	0.9	91.9
0.95	0.85	0.95	0.8	0.75	0.88	0.88	0.75	0.8	0.7	92.7
0.95	0.8	0.88	0.95	0.95	0.75	0.9	0.8	0.95	0.7	96.1

3. Results

1) According to the program analysis the maximum differences between the actual and predicted productivity 0.65 and the minimum is 0 , but the mean actual productivity is 94.043 which is equal to the mean predicted value .
2) The most effective factor is the slope of 24 % importance least effective factor is the rolling resistance of 4% importance.
3) The regression equation is equation :

$$P=9.597 + 12.520\ (\textbf{soil type}) + 7.083\ (\textbf{RR}) + 11.229\ (\textbf{weather}) + 11.215\ (\textbf{loading}) + 7.792\ (\textbf{choice of equip.}) + 9.495(\textbf{bonus}) + 10.392(\textbf{experience}) + 8.965\ (\textbf{maintenance}) + 10.559(\textbf{distance}) + 9.588(\textbf{slope})$$

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Author Profile

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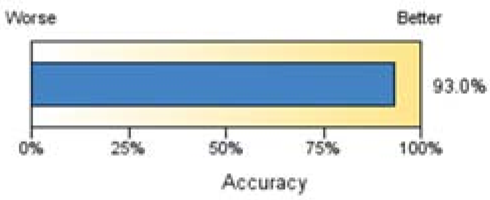
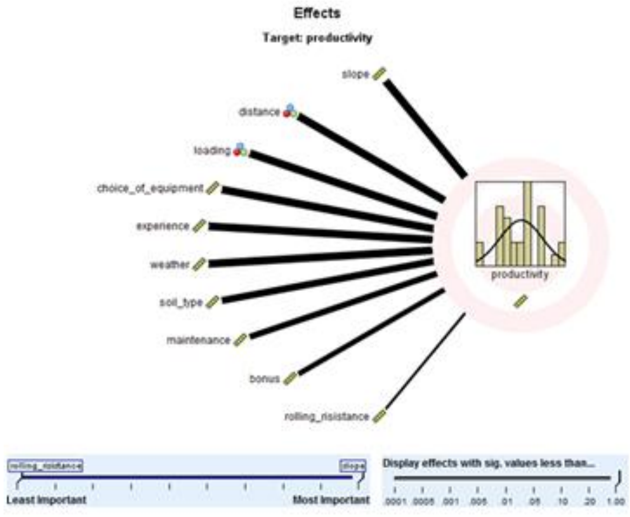
Regression Model from the program

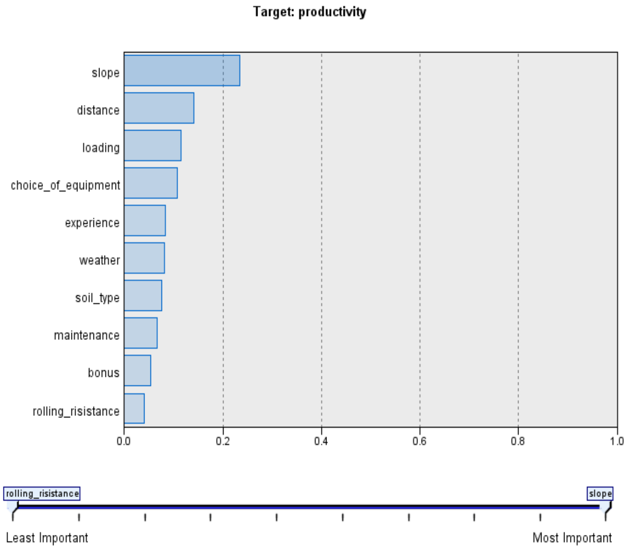
Model Summary

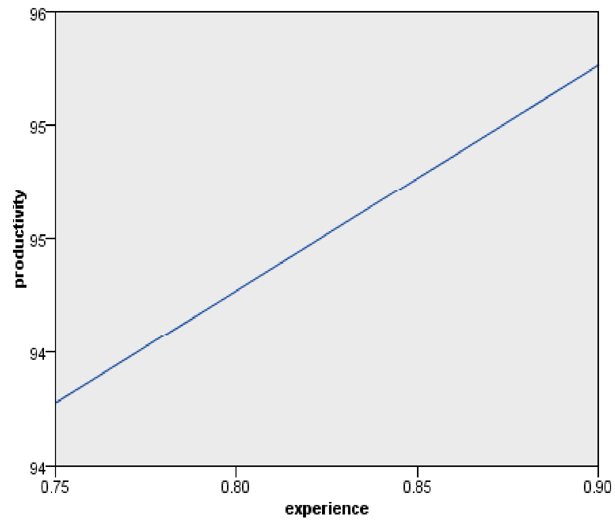
Target	productivity
Automatic Data Preparation	Off
Model Selection Method	None (All Predictors Entered)
Information Criterion	-13.466

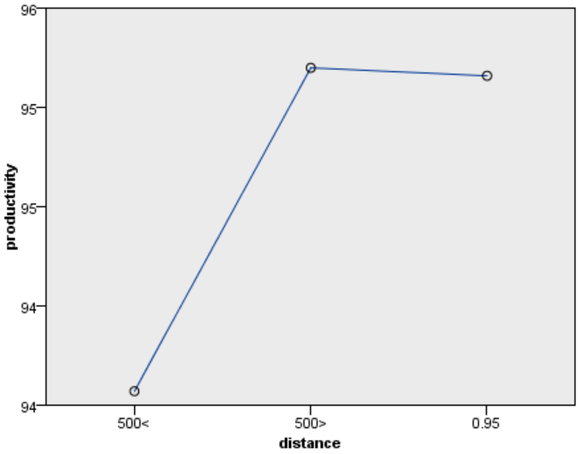
The information criterion is used to compare to models. Models with smaller information criterion values fit better.

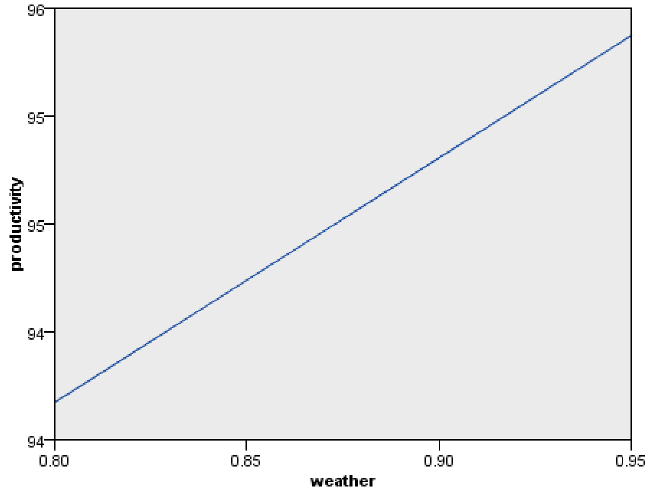


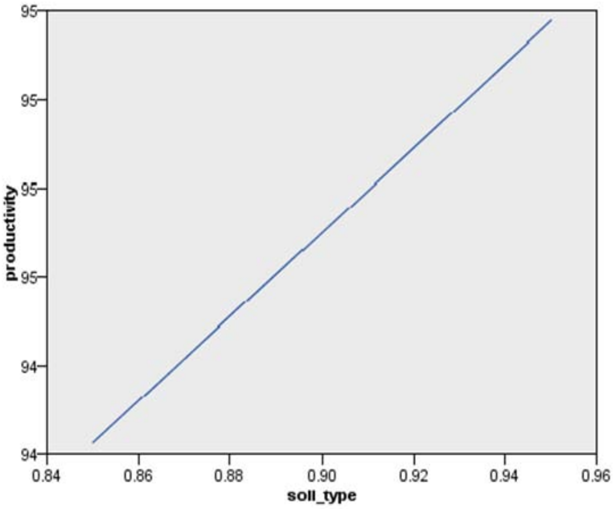


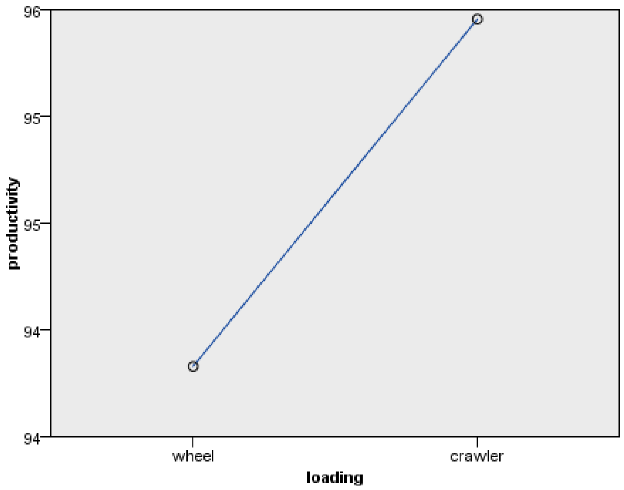


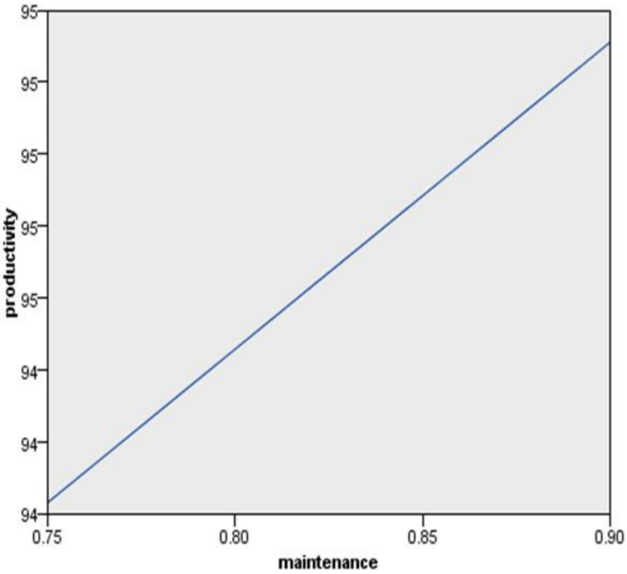


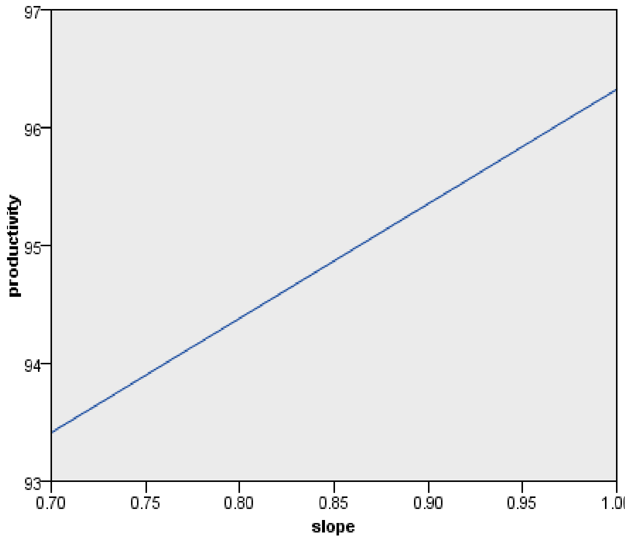




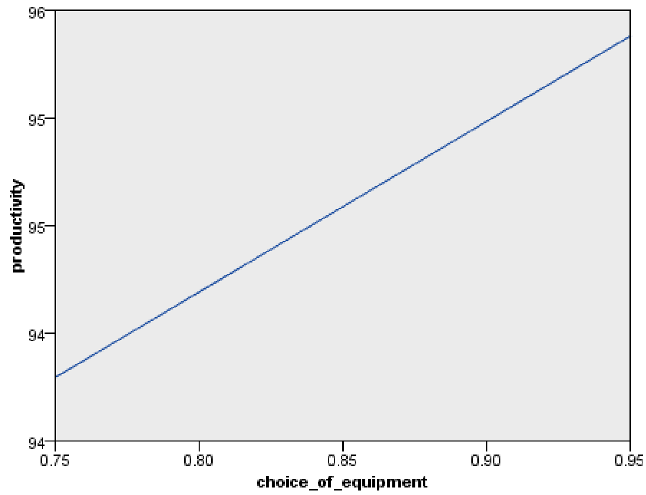








Paper ID: ART20164588 DOI: 10.21275/ART20164588


96
95
95
94
94
productivity
0.75
0.80
0.85
0.90
0.95
choice_of_equipment